Characterization of Groundwater Recharge and Flow in a Vermont Upland Watershed Using Stable Isotope Tracing Techniques

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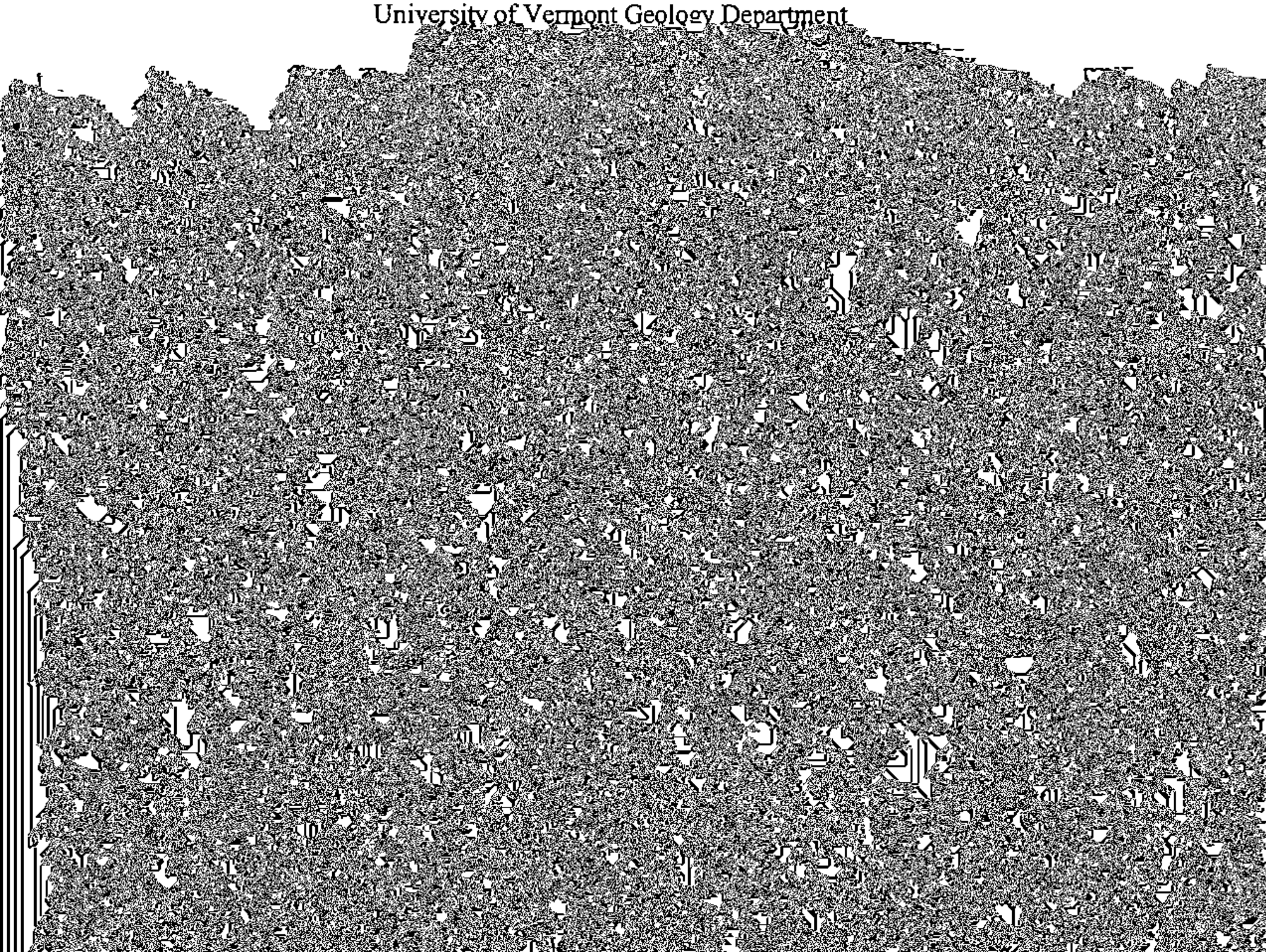
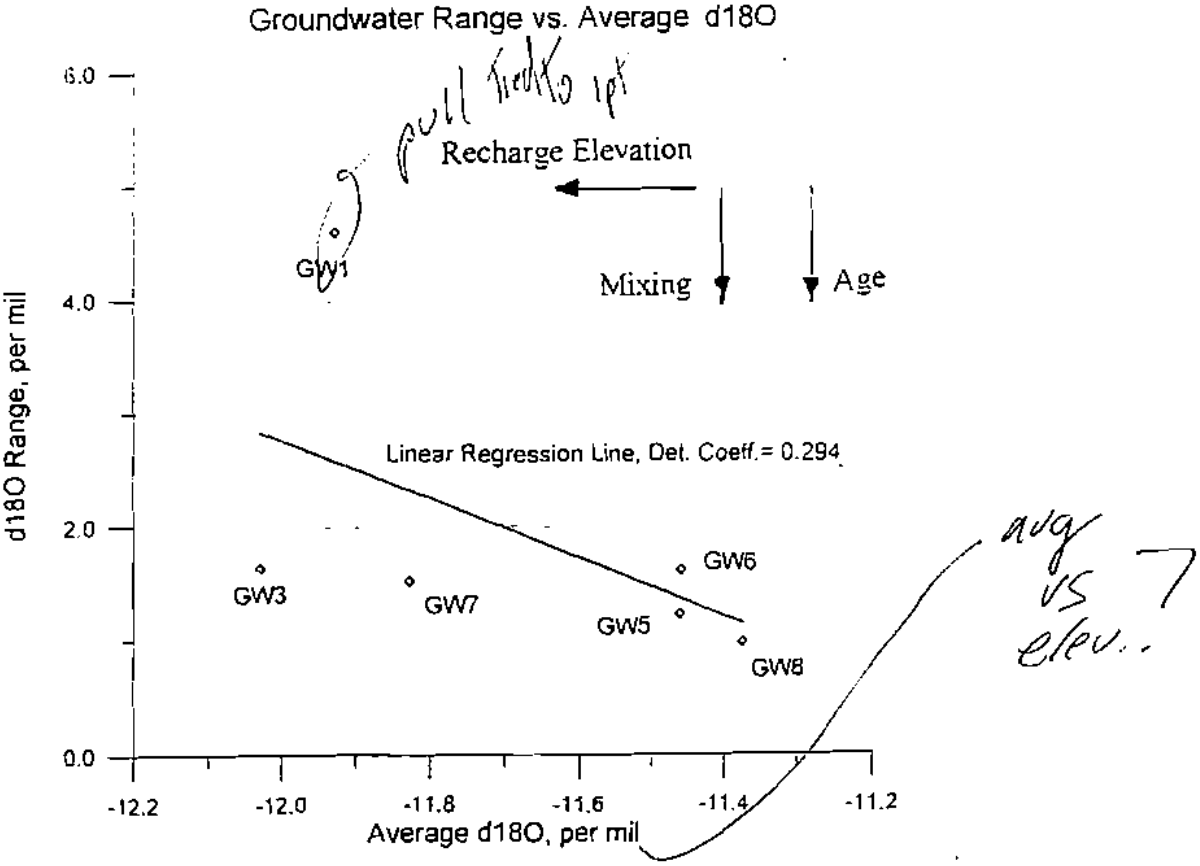


Water Sampling and Analysis

In July of 1995, I began collection of precipitation samples on a weekly basis at 16 stations in Jericho and Underhill in order to determine the spatial and temporal distribution of rain and snow volumes and to monitor the isotopic composition of recharge to groundwater. Rain is collected in a buried glass bottle fed by a plastic funnel. Snow is collected via coring of the snow pack, and as meltwater in lysimeters placed at the ground surface.

Water and snow samples are measured for $\delta^{18}O$ composition (ratio of heavy to light oxygen isotopes) at the University of Vermont isotope laboratory. I have observed a fairly consistent decrease in $\delta^{18}O$ composition with elevation in weekly samples which is suspected to be a response to colder average temperatures at the high elevations in the basin.

After approximately 4 months of monitoring, the number of precipitation monitoring



pull trend to 1pt

avg vs elev..?

Figure 6 - Groundwater $\delta^{18}O$ Composition Range vs. Average

composition (higher recharge elevations) respond more dynamically to recharge input. The wells with a higher magnitude of response may be supplied with younger water (i.e. short residence time with little opportunity for mixing) or water flowing in deep, isolated fracture systems. Again, at least one full year of data collection is necessary to study these patterns

(predominantly on Mt. Mansfield where cover is thinnest), aperture and orientation of individual fractures as well as fracture set density will be measured and recorded. The goal of fracture trace analysis is to provide information on potential influence of fracture set orientation and interconnectivity on groundwater flow in the basin. This interpretation will be used in the development of the groundwater model discussed above.

In selected groundwater samples collected over the past year, I will attempt to determine the absolute ages of the water using one or more dating techniques. The two main techniques being considered are the Tritium (^3H) and Tritium/Helium ($^3H/^3He$) dating methods. The ^3H dating method uses a comparison of [illegible] concentrations of ^3H in [illegible] with [illegible]

Bibliography

Christman, *Geology of the Mount Mansfield Quadrangle Vermont*, Vermont Geological Survey Bulletin No. 12, 1959, pgs. 1-75

Christman and Secor, *Geology of the Camels Hump Quadrangle Vermont*, Vermont Geological Survey Bulletin No. 15, 1961, pgs. 1-70

Fontes, *Environmental Isotopes in Groundwater Hydrology*, in *Handbook of Environmental*